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necessitate a modification of the current theories for the development of salt marshes, and lead DAVIS to conclude that "salt marshes in the area under consideration are features of and an accompaniment to coastal subsidence." The rate of subsidence is variously estimated by these and other investigators at from rather less than one foot per century to double that amount.

BARTLETT shows that a close relation exists between the chlorine content of the soil water and the limits of the various plant associations in the salt marsh. Similar data are given by HARSHBERGER¹³ for some of the salt marshes of New Jersey. These are mostly formed behind barrier beaches and are of relatively small area. Probably the most valuable portions of this paper are careful plant lists and the plotting of the vegetation of various typical areas, which will permit further investigators to trace with exactness the development and succession of the various plant associations. It also affords records of the natural vegetation in a region where man is making such changes in the surface and drainage that the original plant associations are rapidly disappearing. Similar records are also given for certain fresh water ponds and swamps formed by the advance of sand dunes across the outlet of various streams.—GEO. D. FULLER.

Biological life forms.—RAUNKIAER's application of his biological life forms to phytogeography has been translated into German by Miss TOBLER,¹⁴ so that his interesting results are now available to a wider circle of readers. His classification of plants into thirty biological types, based primarily upon the method by which the plant passes the unfavorable season of the year, has already been discussed in this journal.¹⁵ These have now been reduced to ten somewhat broader groups: stem succulents, epiphytes, megaphanerophytes and mesophanerophytes, microphanerophytes, nanophanerophytes, chamaephytes, hemicryptophytes, geophytes, helophytes and hydrophytes, and therophytes or annuals. The flora of a region is then classified into these ten groups, and the number of species in each group expressed in per cent of the total. This numerical arrangement is called a biological spectrum. By arranging these spectra for different regions in order, there is given an easy method of comparing the life forms of vegetation, not only with each other, but also with the flora of the world as a whole. From these spectra it is seen that the tropics are characterized by an excess of the various classes of phanerophytes, deserts by chamaephytes and therophytes, the temperate zone by hemicryptophytes, and the arctics by hemicryptophytes and chamaephytes. For the more northern floras the author finds that the number of chamaephytes

¹³ HARSHBERGER, JOHN W., The vegetation of the salt marshes and of the salt and fresh water ponds of northern coastal New Jersey. Proc. Acad. Nat. Sci. Philadelphia 61: 373-400. 1909.

¹⁴ RAUNKIAER, C., Statistik der Lebensformen als Grundlage für die biologische Pflanzengeographie. Beih. Bot. Centralbl. 27²: 171-206. 1910.

¹⁵ BOT. GAZETTE 44: 392. 1907.

is especially significant. From an exhaustive study of local floras he has drawn circumpolar biochores, connecting regions with similar proportions of chamaephytes. The biochores of 10 per cent, 20 per cent, and 30 per cent are chosen to separate four floral zones, which he distinguishes as follows: a cold temperate or hemicryptophyte zone, south of the 10 per cent biochore; a boreal zone, between the 10 per cent and 20 per cent biochores; an arctic zone, between the 20 per cent and 30 per cent biochores; and an arctic-nival zone beyond the 30 per cent line. The same methods are also applied to alpine floras, and the number of chamaephytes is found to increase in the same way with the altitude. RAUNKIAER's chief object is apparently the recognition of certain types of climate, the results of which are expressed in the vegetation. His methods will probably have a much greater value in characterizing floral regions, irrespective of their climate, and will have the great advantage of basing the distinctions between regions upon the plants themselves, rather than upon any physical feature of the environment. It remains to be seen whether his chief biochores, chosen at certain round numbers and from one life form only, will eventually prove to be the most important.—H. A. GLEASON.

Gas movement.—OHNO¹⁶ has uncovered a most interesting situation in the rapid gaseous output from the leaf of *Nelumbo nucifera*. It is borne some distance above the water, and in the central region over the petiole there is a considerable depression. If on a warm sunny day one places some water in this depression, he will see a rapid extrusion of gas, which amounts to several times the volume of the leaf in a relatively short period. Analysis shows that the gas contains the percentage of O₂ found in air. A like volume is given off by a detached leaf with its petiole in water, even in darkness if the upper surface is warmed. All these facts show that it is not O₂ produced by photosynthesis, and indicate that it is air. Any condition that keeps the air over the leaf dry, sets up such an extrusion of gas. The phenomenon is best explained by the behavior of a model made by OHNO, which he states is a modification of forms before used, to show, in other connections, the physical principle which he believes is applicable here.

A porous clay cup is filled with moist sphagnum and the open end supplied with a one-holed rubber stopper and glass and rubber tubing. The end of the latter dips just a little under the water. The porous cup is heated gently on a warming stage. The air begins streaming out of the tube and continues until it amounts to several times the volume of the porous cup. It ceases only when the water supply of the sphagnum is exhausted. The air on the outside of the tube is relatively dry and the gas pressure there is mainly air. Inside there is a considerable water vapor pressure which decreases the air density. For this reason there is an inward diffusion of air, and, according to the Graham law, an even more rapid outward diffusion of water vapor. The lost water vapor is constantly resupplied by the moist sphagnum. There results an

¹⁶ OHNO, N., Ueber lebhaftes Gasausscheidung aus den Blättern von *Nelumbo nucifera* Gaertn. Zeitschr. Bot. 2:641-664. 1910.